Hovercraft

Science Olympiad

Division B Invitational

Team Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Team Number: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Student Names: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Instructions:

1. You will have **at least 20 minutes** to take this test.

2. Please write your answers **rounded to 3 decimal places**. Do not use significant figures when rounding.

3. You may take apart the test, but please put the pages in order before turning in.

4. Please write legibly and make sure your answers are clearly indicated. Answers must have the **correct units**. No partial credit is given.

5. Please use the approximation of **9.8 m/s2** for the acceleration of gravity.

6. This test is worth a total of **50** points.

**Section A** – 1 point each **(10 points) - *Name the SI units for:***

1. Work \_\_\_\_\_\_\_\_\_\_\_\_\_
2. Power \_\_\_\_\_\_\_\_\_\_\_\_\_
3. Velocity \_\_\_\_\_\_\_\_\_\_\_\_\_
4. Displacement \_\_\_\_\_\_\_\_\_\_\_\_\_
5. Momentum \_\_\_\_\_\_\_\_\_\_\_\_\_
6. Kinetic Energy \_\_\_\_\_\_\_\_\_\_\_\_\_
7. Acceleration \_\_\_\_\_\_\_\_\_\_\_\_\_
8. Force \_\_\_\_\_\_\_\_\_\_\_\_\_
9. Impulse \_\_\_\_\_\_\_\_\_\_\_\_\_
10. Potential Energy \_\_\_\_\_\_\_\_\_\_\_\_\_

**Section B** – **(5 points)** - ***Fill in the blanks:***

1. The sum of all forces acting on an object is called the \_\_\_\_\_\_\_\_\_\_\_\_ force
2. Energy of things in motion is called \_\_\_\_\_\_\_\_\_\_\_\_ energy
3. Force exerted on rope/string is called \_\_\_\_\_\_\_\_\_\_
4. In all collisions, with no net impulse impacting the collision, \_\_\_\_\_\_\_\_\_\_\_ is conserved.
5. \_\_\_\_\_\_\_ is a push or a pull.

**Section C** – **(5 points)** – ***State whether True or False***

1. An unbalanced force must be present to keep an object in motion.
2. A free-falling object has an unbalanced force acting on it.
3. Accelerating objects are either slowing down or speeding up.
4. A heavier object requires a greater applied force to move it than a less heavy object.
5. The amount of matter in an object is called its weight.

**Section D** – **(12 points)** ***– Choose the correct answer***

1. If A pushes an object towards B with 12 Newtons of force, and B pushes the object back towards A with 3 Newtons of force, which way will the object move?
2. towards A (15 Newtons)
3. towards B (15 Newtons)
4. towards A (9 Newtons)
5. towards B (9 Newtons)
6. Bullet getting lodged in a sandbag is an example of
7. Elastic collision
8. Perfectly elastic collision
9. Inelastic collision
10. Perfectly inelastic collision
11. When a gun is fired, the momentum of the bullet
12. Is less than the momentum of the gun and in the same direction
13. Is greater than the momentum of the gun and in the opposite direction
14. Is equal to the momentum of the gun and in the opposite direction
15. Is equal to the momentum of the gun and in the same direction
16. Momentum
17. Is inertia of moving objects
18. Is a vector quantity
19. Is dependent on an object’s velocity
20. All the above
21. A baseball player, to reduce the impact force on his hand while catching a ball, extends hand forward before impact with the ball, then lets his hand ride backward in the direction of the ball’s motion. This is mainly
    1. Force of impact is reduced
    2. Velocity of ball decreases
    3. Time of impact is increased
    4. Ball comes to a stop
22. A 4kg mass is pushed to the left with 24N, and to the right with 12N. What is the acceleration
23. 6 m/s2 to left
24. 6 m/s2 to right
25. 3 m/s2 to left
26. 3 m/s2 to right
27. The area of a force-time graph denotes
28. Distance moved
29. Acceleration
30. Change of momentum
31. Change of velocity
32. A wagon is being pulled in a straight line. The forces exerted on the wagon are unbalanced in the direction opposite to its motion. The wagon
    1. speeds up
    2. moves with a constant speed
    3. slows down
    4. does not move
33. You push a box on a smooth frictionless ice rink. While you push
    1. force is transferred to the box.
    2. energy is transferred to the box.
    3. force and energy are transferred to the box.
    4. neither force nor energy are transferred to the box.
34. Two identical carts are filled with different amounts of water bottles such that cart A has a much greater mass than cart B. Both carts are given the same initial push. Which cart slows down faster?
    1. Cart A slows down faster because it has more mass
    2. Cart B slows down faster because it has less mass
    3. Cart B slows down at the same rate as Cart A since they were given same initial push.
    4. Cannot be determined from the given information
35. Which of the following would produce the greatest increase in the kinetic energy of a moving object?
    1. Doubling its mass
    2. Doubling its velocity
    3. Halving its mass
    4. Halving its velocity
36. Gravitational potential energy is
    1. Mass times gravity
    2. Weight times height
    3. Gravity times height
    4. Mass times distance

**Section E** – **(18 points)** ***– Answer the following:***

1. A 2500-kg truck moving with a velocity of 13 m/s hits a 1200-kg parked car. The impact causes the 1200-kg car to be set in motion at 8 m/s. Assuming momentum is conserved during the collision, determine the velocity of the truck immediately after the collision.
2. A car drives straight off the edge of a 62m high cliff. The point of impact on the ground is determined to be 120 m from the base of the cliff. How fast was the car traveling when it went over the cliff?
3. A baseball player applies an average force of 60.0 N with the baseball bat to a 0.32 kg baseball for a time of 0.12 seconds. Determine the impulse experienced by the baseball.
4. Determine the horizontal and vertical components of the initial velocity values associated with a projectile launched with a speed of 40 m/s at an angle of 60 degrees to the horizontal.
5. A sled weighing 200 kg along with its rider has a positive acceleration of 3 m/s2. At any moment in time, forces resisting its motion amount to 400 N. Find the magnitude of the force propelling the sled forward.
6. A huge truck moving at 40 m/s has approximately 360 000 Joules of kinetic energy. Estimate its new kinetic energy if it is moving at 20 m/s.